D H E C

PROMOTE PROTECT PROSPER

South Carolina Department of Health and Environmental Control

Memorandum

Aquatic Biology Section

To. Kathy Stecker
Watershed and Planning Section, Manager

From: James Glover, Ph D James Glover
Aquatic Biology Section

Through Edward Younginer
Aquatic Biology Section, Manager

Subject A macroinvertebrate biological assessment of a sediment release in Twelve Mile Creek below a small reservoir in Pickens County, SC Technical Report-013-00

Find attached a copy of the above referenced report. If you have questions or comments concerning the report please feel free to contact me.

Cc. Chester Sansbury, SCDHEC, w/ attachment
David Baize, SCDHEC, w/ attachment
Craig Zeller, USEPA Region 4, w/ attachment
Diane Duncan, US Fish and Wildlife Service, w/ attachment
Gerrit Jobsis, SCDNR, w/ attachment
Larry Dyck, Clemson University, w/ attachment
John Morse, Clemson University, w/ attachment

A MACROINVERTEBRATE BIOLOGICAL ASSESSMENT OF A SEDIMENT RELEASE IN TWELVE MILE CREEK BELOW A SMALL RESERVOIR IN PICKENS COUNTY, SC

By- James B. Glover, Ph.D.

The South Carolina Department of Health and Environmental Control
Bureau of Water
Water Monitoring, Assessment, and Protection Division
Aquatic Biology Section
TR-013-00

As part of a sediment management plan, a proposal was made for sediment within Woodside II Reservoir, a small reservoir on Twelve Mile Creek, Pickens Co , SC, to be pumped over the dam and released into the creek It was hoped that the sediment would be carried downstream and be deposited within Lake Hartwell, a PCB contamination superfund site

In response to a citizen's request, personnel from the South Carolina Department of Health and Environmental Control (SCDHEC) initiated a macroinvertebrate biological study of Twelve Mile Creek in October of 1998 There was concern that the sediment being carried downstream would impair the aquatic life within Twelve Mile Creek as well as impede recreational uses enjoyed by citizens along that stretch of stream

The objective of this study was to determine the impact of this sediment release project on the aquatic macroinvertebrate community within Twelve Mile Creek This study does not address the impact on benthic algae, fish communities, other flora and fauna in and along the stream, or recreational uses by citizens

Materials and Methods

Twelve Mile Creek, located in Pickens County, SC, flows in a south-western direction and enters Lake Hartwell near the Pickens County/Oconee County border (Fig 1). The creek has been highly modified over the years by small impoundments along its length as well as being consumed by Lake Hartwell in its lower reach Other impacts include nonpoint source pollution from urbanized and agricultural areas as well as point source discharges along its length. At one time riffles and runs probably dominated the stream but now much of the rock-gravel habitat is either buried in sediment or covered in water from the reservoirs There are still patches of the stream that probably resembles what the creek once looked like

About a 200 meter stretch of Twelve Mile Creek was sampled below Lay Bridge, Secondary Road 277 (Fig 1) This was approximately 150 meters below the sediment discharge point. The stream in the upper portion of the study area was high gradient and consisted of a rock-gravel habitat. The water was fast-flowing and the alga-like aquatic plant *Podostemon ceratophyllum* Michaux covered the rocks A tremendous amount of sedimentation was present in the lower portion of the study area Very little habitat was present except for a few snags containing small amounts of detritus The velocity was lower here as the stream widened out. Apparently, during certain times of the year, Lake Hartwell inundates this area and at these times it becomes more lentic in nature Approximately 1 5 km of the stream was walked at the time of the first sampling event This stretch of stream appeared very similar to the lower portion of the study area

Because the sediment discharge point was directly below the reservoir an upstream control site could not be established Therefore, a predischarge sample had to be collected and used as the control for the remainder of the study Table 1 shows the dates samples were taken The first sample was collected on 12 October 1998, which was three days before the first sediment release Another sample was collected approximately 1

month later on 10 November 1998 Sediment pumping was ceased two days after this sample was taken on 12 November 1998 Sediment pumping began again on 07 July 1999 and another macroinvertebrate collection was made on 06 August 1999 Pumping was ceased two days later on 08 August 1999 An additional macroinvertebrate collection was made on 08 December 1999

All sampling and data analysis procedures were conducted as described in South Carolina Department of Health and Environmental Control (1998a) Two biologists sampling for 1 hour each (2 man hours) collected a qualitative macroinvertebrate sample from all available habitats within the study area Macroinvertebrates were preserved in 80% ethanol and returned to the laboratory where they were identified to the lowest possible taxonomic level (usually genus or species) Some basic water chemistry data were also collected (Table 2) In addition, habitat assessments were completed during each sampling event (Figs. 2 and 3) Both an instream habitat assessment developed by SCDHEC (1998a) and a habitat assessment described in Barbour et al (1997) were conducted All data were entered into a Microsoft FoxPro for Windows database system

Two major indices were used to determine if and to what extent the stream was impacted The EPT index is the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa collected at a site Most EPT taxa are very intolerant of pollution and, in general, a high EPT count indicates good water quality

The biotic index (BI) is the average pollution tolerance of all organisms collected (based on assigned index values for taxa) and the calculation factors in relative abundances The index is based on a scale from 0-10, with 10 representing the poorest water quality

$$BI=\sum(Tv_i)(n_i)/N$$

Tv_i= $_i$th taxon tolerance value
n_i= $_i$th taxon abundance value
N= sum of all taxon abundance values

Bioclassification of streams in South Carolina is based on the combination of equally weighted BI and EPT scores:

Excellent = 5 Good = 4 Good-Fair = 3 Fair = 2 Poor = 1

A comparison of the final bioclassification score of the control with the test sample is used to assess impairment of a steam The following represents the levels of impairment and their associated change in bioclassification scores.

Level of Impairment	Decrease in Bioclassification Score
Unimpaired	≤0 4
Slightly Impaired	0 6-1 4
Moderately Impaired	1 6-2 4
Severely Impaired	≥2 6

If the decrease is 0 5, 1 5, or 2 5, professional judgement is used to decide whether to move up or down on the scale Taxa Richness, Total Count, and other indices are often used to help determine level of impairment in this situation

The North Carolina Department of Environment, Health, and Natural Resources (1997) noted that the "BI may not measure impacts that are largely due to sediment " and "for sites where such habitat changes are the primary cause of stress, the biotic index rating should be used with caution ." Because sediment was the variable of concern in this study the change in EPT Score alone was also used to assess impact

For a more complete discussion of materials and methods see SCDHEC (1998a)

Results and Discussion

Habitat Assessment

The SCDHEC habitat assessment conducted on 12 October 1998 (the control) revealed that the majority of the instream habitat consisted of rock-gravel (Fig 2) This was located in the upper portion of the study area as described in the materials and methods No root banks were present, and very few logs/sticks/snags were found Two buried logs in the lower portion of the study area contained a small to moderate amount of mature leaf pack. On 10 November 1998, one month after the initiation of sediment release, the habitat assessment was very much the same (Fig. 2) While there was a tremendous amount of sediment in the water column, the riffle area appeared to still be intact. The rock/gravel/riffle score did decrease from 5 to 4 because of some bar formation In the lower portion of the study area the mature leaf pack score decreased from 2 too 1 On 6 August 1999 the habitat assessment score had changed considerably The riffle area was almost completely covered over by sediment Only a small amount of riffle area was left and very few rocks remained exposed In the lower portion of the study area several large sand bars had formed that were not observed before On 8 December 1999, the habitat assessment was similar to the control The sediment, which had nearly covered the riffle zone, had been moved out. However, the sand bars that were observed on 6 August 1999 appeared to have grown in size in the lower unit of the study area

The habitat assessment described in Barbour et al. (1997) produced a similar trend as the above (Fig. 3). An assessment score of 121 (out of a maximum of 200) was calculated for the control sample. It had decreased to 96 on 6 August 1999 but had returned to 125 by 8 December 1999

All water chemistry parameters measured were within the limits set for South Carolina Class FW water (Table 2) (SCDHEC, 1998b)

Aquatic Macroinvertebrates

The macroinvertebrate collection on 12 October 1998 showed that Twelve Mile Creek had a diverse community of aquatic macroinvertebrates (Table 1) Forty-two taxa were recovered with 22 being EPT taxa (Figs 4 and 5) A bioclassification score of 4 2 was calculated for this sample which resulted in a bioclassification of Good (Table1, Fig 6) On 10 November 1998 the taxa richness score was reduced to 24 and the EPT Index was down to 14 (Figs. 4 and 5). The bioclassification was reduced from 4 2 to 3 7 which was a change of 0 5 This resulted in an evaluation of slightly impaired (Table 1, Fig 6) The EPT score was lowered by 1 0, which also produced an evaluation of slightly impaired

On 06 August 1999, the taxa richness improved to 35 but was still lower than that of the control (Fig. 4). The EPT index was also up, but still lower than the control (Fig 5) The change in bioclassification score of 0 4 resulted in an evaluation of no impairment while the EPT score change of 0 8 indicated slight impairment (Table 1, Fig 6)

The sample collected on 08 December 1999 produced results remarkably similar to that of 06 August 1999 (Table 1, Figs 4-6) The bioclassification score change of 0 4 resulted in an evaluation of no impairment and the EPT score change of 0 8 suggested slight impairment.

Discussion

The results of this study suggest that the sediment release project caused a slight impact to the aquatic macroinvertebrate community in Twelve Mile Creek. It further suggests that severe degradation to the instream habitat was caused after several weeks of pumping However, the effects on the habitat in the upper portion of the stream were short lived and the riffle area returned to its prespill condition after the sediment release had ceased. The lower portion of the study area, as well as the remainder of Twelve Mile Creek, had very little habitat present before the pumping began making it difficult to compare predischarge and postdischarge results The stream in this area already contained an extremely large amount of sediment before the pumping began Some new bar formations were observed in this area on the last two sampling dates.

It is difficult to predict the long term effects on the aquatic macroinvertebrate community of intermittent pumping of sediment into Twelve Mile Creek Aquatic macroinvertebrates appear to be fairly resilient to physical disturbance and recruitment into an area can often be fairly rapid if there is a source to draw from. Unfortunately, because of the reservoir immediately upstream, downstream drift is probably negligible Oviposition by terrestrial adults can often reestablish certain populations of macroinvertebrates but at a slower rate than drift

Literature Cited

Barbour, M.T , J Gerritsen, B D Snyder, and J B Stribling 1997 Revision to rapid bioassessment protocols for use in streams and rivers· periphyton, benthic macroinvertebrates and fish EPA 841-D-97-002, Washington, D C

North Carolina Department of Environment, Health and Natural Resources (NCDEHNR) 1997. Standard operating procedures biological monitoring Division of Environmental Management, Water Quality Section, Raleigh, NC

South Carolina Department of Health and Environmental Control 1998a Standard operating and quality control procedures for macroinvertebrate sampling Bureau of Water Columbia, SC Technical Report No 004-98.

South Carolina Department of Health and Environmental Control 1998b Water classifications and standards (Regulation 61-68), classified waters (Regulation 61-69) State of South Carolina. Office of Environmental Quality Control, SC DHEC, Columbia, SC

Table 1 Taxa list of aquatic macroinvertebrates collected in Twelve Mile Creek and a Bioassessment of three samples following a sediment release

PHYLUM	CLASS	ORDER	FAMILY	TAXA	SV-769 10/12/98	SV-769 11/10/98	SV-769 08/06/99	SV-769 12/08/99
Annelida	Hirudinea	NA	NA	Hirudinea			1	
Annelida	Oligochaeta	NA	NA	Oligochaeta	1		3	3
Arthropoda	Crustacea	Decapoda	Cambaridae	Cambaridae		2		
Arthropoda	Hexapoda	Coleoptera	Carabidae	Carabidae			1	
Arthropoda	Hexapoda	Coleoptera	Dryopidae	*Helichus sp*				1
Arthropoda	Hexapoda	Coleoptera	Elmidae	*Ancyronyx variegatus*			1	
Arthropoda	Hexapoda	Coleoptera	Elmidae	*Macronychus glabratus*	3		6	
Arthropoda	Hexapoda	Coleoptera	Elmidae	*Microcylloepus pusillus*	2			
Arthropoda	Hexapoda	Coleoptera	Elmidae	*Promoresia elegans*	1		2	
Arthropoda	Hexapoda	Coleoptera	Elmidae	*Stenelmis sp*			12	
Arthropoda	Hexapoda	Coleoptera	Gyrinidae	*Dineutus sp*		1	1	1
Arthropoda	Hexapoda	Coleoptera	Gyrinidae	*Gyrinus sp*				2
Arthropoda	Hexapoda	Diptera	Chironomidae	*Brillia sp*	1			
Arthropoda	Hexapoda	Diptera	Chironomidae	*Cardiocladius sp*				2
Arthropoda	Hexapoda	Diptera	Chironomidae	*Corynoneura sp*	1			
Arthropoda	Hexapoda	Diptera	Chironomidae	*Cricotopus/Orthocladius*				4
Arthropoda	Hexapoda	Diptera	Chironomidae	*Diamesa sp*				4
Arthropoda	Hexapoda	Diptera	Chironomidae	*Eukiefferiella sp*				5
Arthropoda	Hexapoda	Diptera	Chironomidae	*Parametriocnemus lundbecki*				2
Arthropoda	Hexapoda	Diptera	Chironomidae	*Polypedilum halterale*	1			
Arthropoda	Hexapoda	Diptera	Chironomidae	*Polypedilum illinoense*			2	
Arthropoda	Hexapoda	Diptera	Chironomidae	*Stenochironomus sp*			1	
Arthropoda	Hexapoda	Diptera	Chironomidae	*Tvetenia sp*	1			
Arthropoda	Hexapoda	Diptera	Simuliidae	*Simulium sp*	9		7	25
Arthropoda	Hexapoda	Diptera	Tipulidae	*Tipula sp*	2	1		3
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Acentrella sp*	1			
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Baetis (Pseudocloeon) sp*			3	3
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Baetis flavistriga*				1
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Baetis intercalaris*	9	1	11	
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Baetis pluto*	1	1	3	
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Heterocloeon sp*	3		26	2
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Labiobaetis frondalis*	1			
Arthropoda	Hexapoda	Ephemeroptera	Baetidae	*Labiobaetis propinquus*			6	
Arthropoda	Hexapoda	Ephemeroptera	Ephemerellidae	*Ephemerella sp*				1
Arthropoda	Hexapoda	Ephemeroptera	Ephemerellidae	*Eurylophella sp*				1

Table 1 Taxa list of aquatic macroinvertebrates collected in Twelve Mile Creek and a Bioassessment of three samples following a sediment release

PHYLUM	CLASS	ORDER	FAMILY	TAXA	SV-769 10/12/98	SV-769 11/10/98	SV-769 08/06/99	SV-769 12/08/99
Arthropoda	Hexapoda	Ephemeroptera	Ephemerellidae	*Serratella sp*			1	
Arthropoda	Hexapoda	Ephemeroptera	Heptageniidae	*Stenacron interpunctatum*	1			
Arthropoda	Hexapoda	Ephemeroptera	Heptageniidae	*Stenonema modestum*	38	11	15	38
Arthropoda	Hexapoda	Ephemeroptera	Isonychiadea	*Isonychia sp*	17	5	14	3
Arthropoda	Hexapoda	Ephemeroptera	Tricorythidae	*Tricorythodes sp*	1		2	
Arthropoda	Hexapoda	Megaloptera	Corydalidae	*Corydalus cornutus*	19	9	13	4
Arthropoda	Hexapoda	Megaloptera	Corydalidae	*Nigronia serricornis*		1		
Arthropoda	Hexapoda	Megaloptera	Corydalidae	*Nigronia sp*			9	
Arthropoda	Hexapoda	Odonata	Aeshnidae	*Boyeria vinosa*	9	6	3	4
Arthropoda	Hexapoda	Odonata	Calopterygidae	*Calopteryx sp*				1
Arthropoda	Hexapoda	Odonata	Coenagrionidae	*Argia sp*	1			
Arthropoda	Hexapoda	Odonata	Gomphidae	*Dromogomphus sp*	1			
Arthropoda	Hexapoda	Odonata	Gomphidae	Gomphidae	1		1	
Arthropoda	Hexapoda	Odonata	Gomphidae	*Gomphus sp*	1			1
Arthropoda	Hexapoda	Odonata	Gomphidae	*Hagenius brevistylus*	1		1	
Arthropoda	Hexapoda	Odonata	Gomphidae	*Ophiogomphus sp*		1		
Arthropoda	Hexapoda	Odonata	Gomphidae	*Progomphus sp*	4	2		2
Arthropoda	Hexapoda	Odonata	Libellulidae	*Libellula sp*				1
Arthropoda	Hexapoda	Odonata	Macromiidae	*Macromia sp*	1	1	3	4
Arthropoda	Hexapoda	Plecoptera	Capniidae	*Allocapnia sp*				5
Arthropoda	Hexapoda	Plecoptera	Peltoperlidae	*Tallaperla sp*	2	1		
Arthropoda	Hexapoda	Plecoptera	Perlidae	*Acroneuria sp*	4	2		
Arthropoda	Hexapoda	Plecoptera	Perlidae	*Acroneuria/Eccoptura*			2	
Arthropoda	Hexapoda	Plecoptera	Perlidae	*Paragnetina fumosa*	18	11	3	2
Arthropoda	Hexapoda	Plecoptera	Perlodidae	*Agnetina sp*	1	5		
Arthropoda	Hexapoda	Plecoptera	Perlodidae	*Clioperla clio*				1
Arthropoda	Hexapoda	Plecoptera	Perlodidae	*Helopicus sp*				1
Arthropoda	Hexapoda	Plecoptera	Pteronarcidae	*Pteronarcys dorsata*			2	
Arthropoda	Hexapoda	Plecoptera	Pteronarcidae	*Pteronarcys sp*		2		
Arthropoda	Hexapoda	Plecoptera	Taeniopterygidae	*Taeniopteryx sp*		1		7
Arthropoda	Hexapoda	Trichoptera	Brachycentridae	*Brachycentrus nigrosoma*		1		
Arthropoda	Hexapoda	Trichoptera	Brachycentridae	*Micrasema wataga*			1	
Arthropoda	Hexapoda	Trichoptera	Hydropsychidae	*Ceratopsyche sparna*	10			13
Arthropoda	Hexapoda	Trichoptera	Hydropsychidae	*Cheumatopsyche sp*	7			5
Arthropoda	Hexapoda	Trichoptera	Hydropsychidae	*Hydropsyche venularis*	27	39	49	7

Table 1 Taxa list of aquatic macroinvertebrates collected in Twelve Mile Creek and a Bioassessment of three samples following a sediment release

PHYLUM	CLASS	ORDER	FAMILY	TAXA	SV-769 10/12/98	SV-769 11/10/98	SV-769 08/06/99	SV-769 12/08/99
Arthropoda	Hexapoda	Trichoptera	Hydropsychidae	*Macrostemum sp*	7	3	2	
Arthropoda	Hexapoda	Trichoptera	Hydroptilidae	*Hydroptila sp*				1
Arthropoda	Hexapoda	Trichoptera	Leptoceridae	*Ceraclea ancylus*		1		
Arthropoda	Hexapoda	Trichoptera	Leptoceridae	*Nectopsyche exquisita*	1		1	
Arthropoda	Hexapoda	Trichoptera	Leptoceridae	*Oecetis morsei/sphyra*			2	
Arthropoda	Hexapoda	Trichoptera	Leptoceridae	*Oecetis persimillis*	1			
Arthropoda	Hexapoda	Trichoptera	Philopotamidae	*Chimarra sp*	1			2
Arthropoda	Hexapoda	Trichoptera	Philopotamidae	*Dolophilodes sp*	1			
Arthropoda	Hexapoda	Trichoptera	Polycentropodidae	*Neureclipsis sp*	1			
Mollusca	Pelecypoda	Heterodonta	Corbiculidae	*Corbicula fluminea*	13	4	21	10
				Count-	226	112	231	172
				Taxa Richness-	42	24	35	36
				EPT Index-	22	14	17	17
				Biotic Index-	4 65	4 49	4 84	5 03
				EPT Score-	3 4	2 4	2 6	2 6
				Biotic Index Score-	5 0	5 0	5 0	5 0
				Combined Score-	4 2	3 7	3 8	3 8
				Bioclassification-	Good	Good	Good	Good
				Aquatic Life Use-	FS*	FS	FS	FS
				Combined Score Change (CSC)	----------	0 5	0 4	0 4
				Impairment Based on CSC	----------	**Slight**	**None**	**None**
				EPT Score Change (EPT SC)	----------	1 0	0 8	0 8
				Impairment Based on EPT SC	----------	**Slight**	**Slight**	**Slight**
				* Fully Supporting				

Table 2. Field water chemistry measurements.

		pH (Units)	DO (ppm)	Water Temp (°C)	Conductivity (umhos/cm)
SV-769	10/12/98	6 35	8 20	19 00	40 00
SV-769	11/10/98	6 35	9 90	14 00	40 00
SV-769	08/06/99	7 15	7 90	25 00	50 00
SV-769	12/08/99	6 85	10 80	5 50	35 00

Figure 1. Twelve Mile Creek, Pickens Co., SC

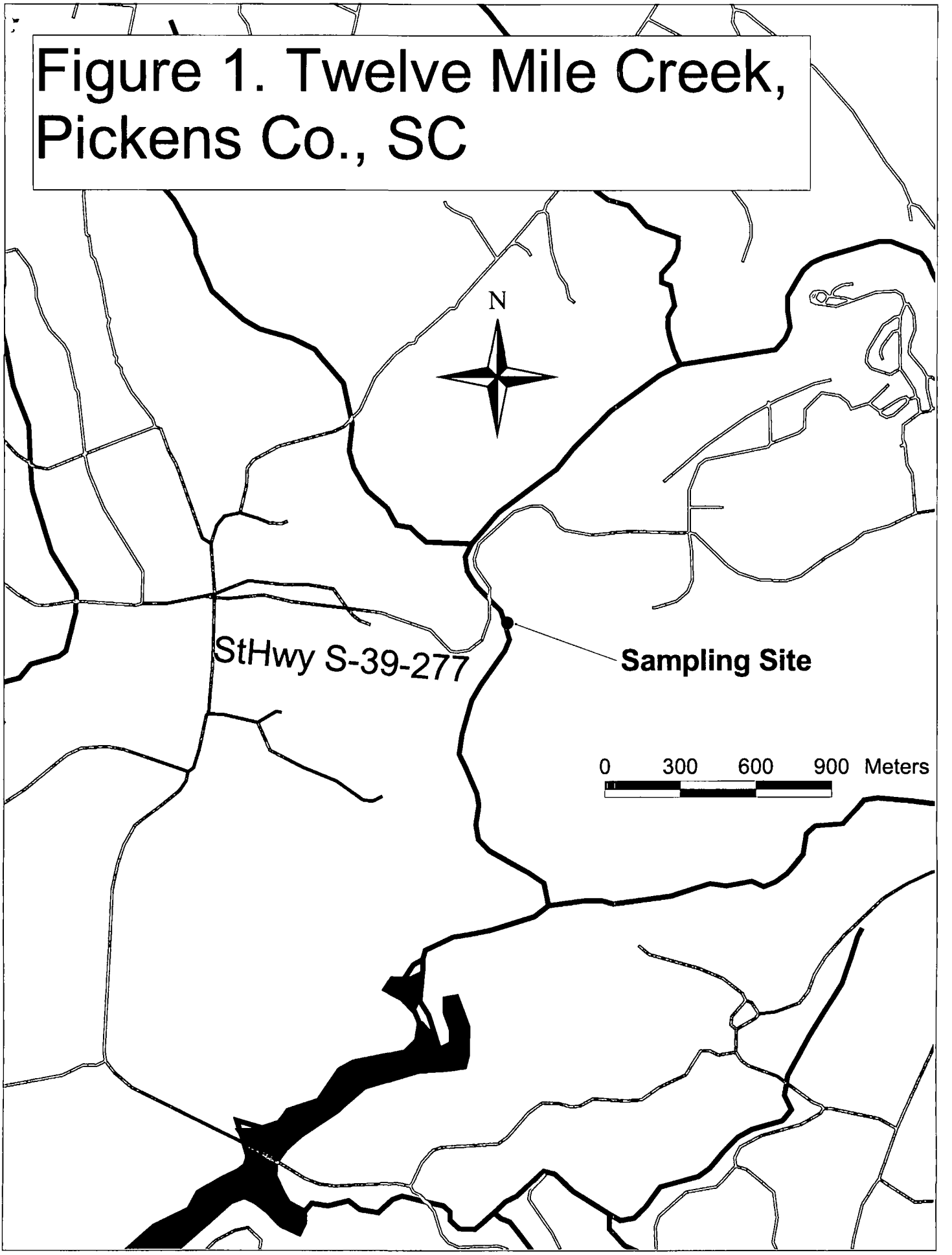
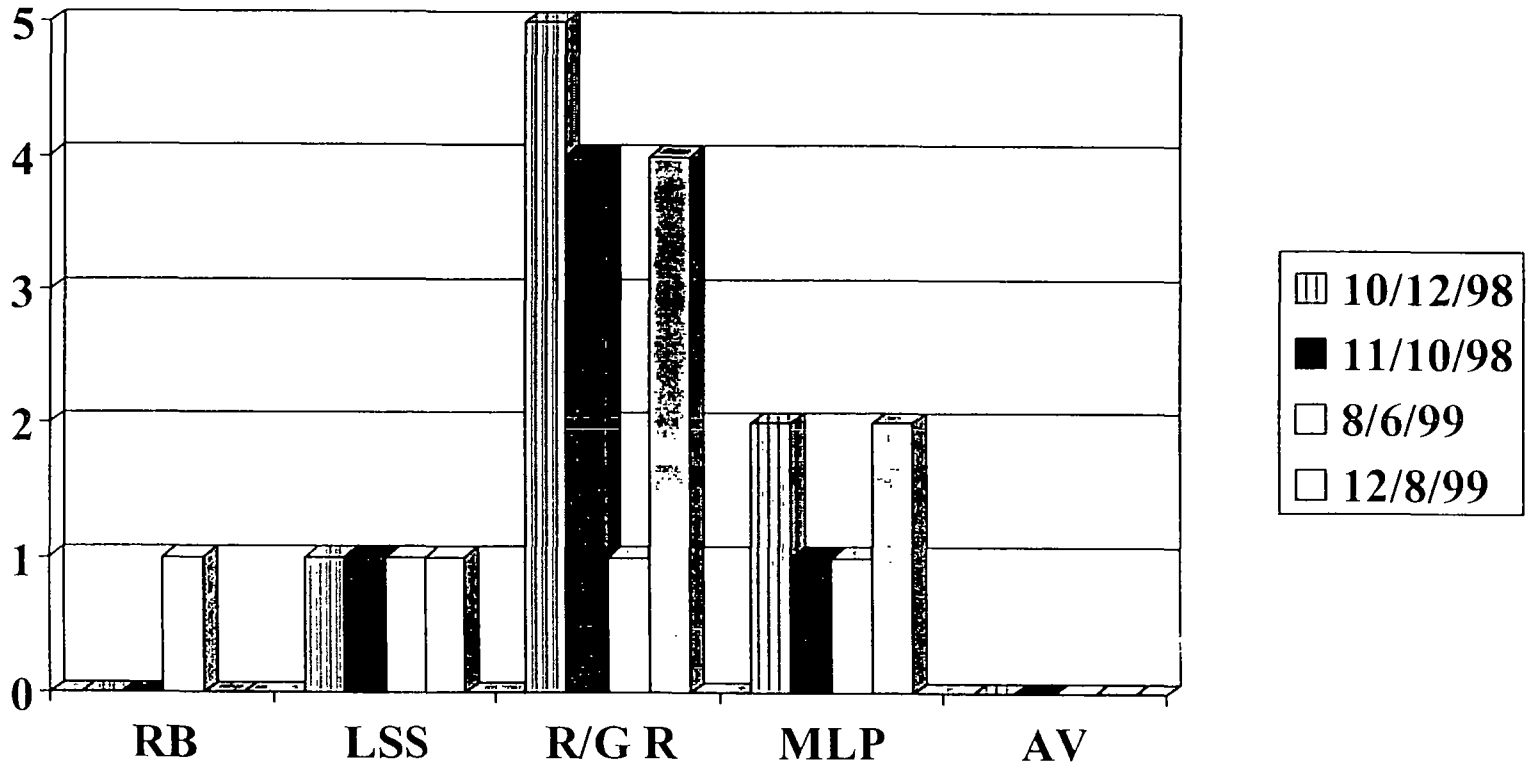


Figure. 2 Habitat Assessment @ SV-769



RB=Root Banks, LSS=Logs/Sticks/Snags, R/G R=Rock/Gravel Riffle, MLP=Mature Leaf Packs, AV= Aquatic Vegetation

Figure 3. RBP Habitat Assessment @ SV-769

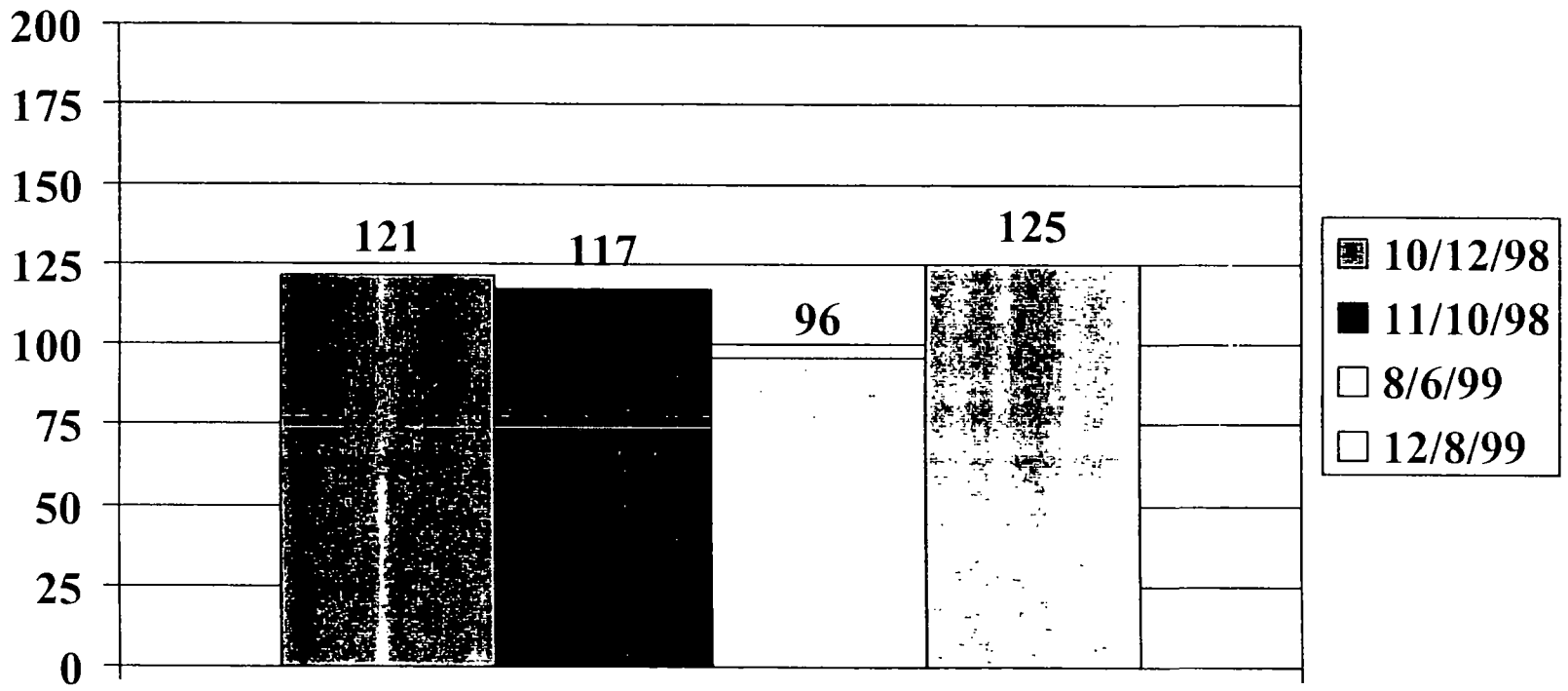


Figure 4. Total Taxa Richness @ SV-769

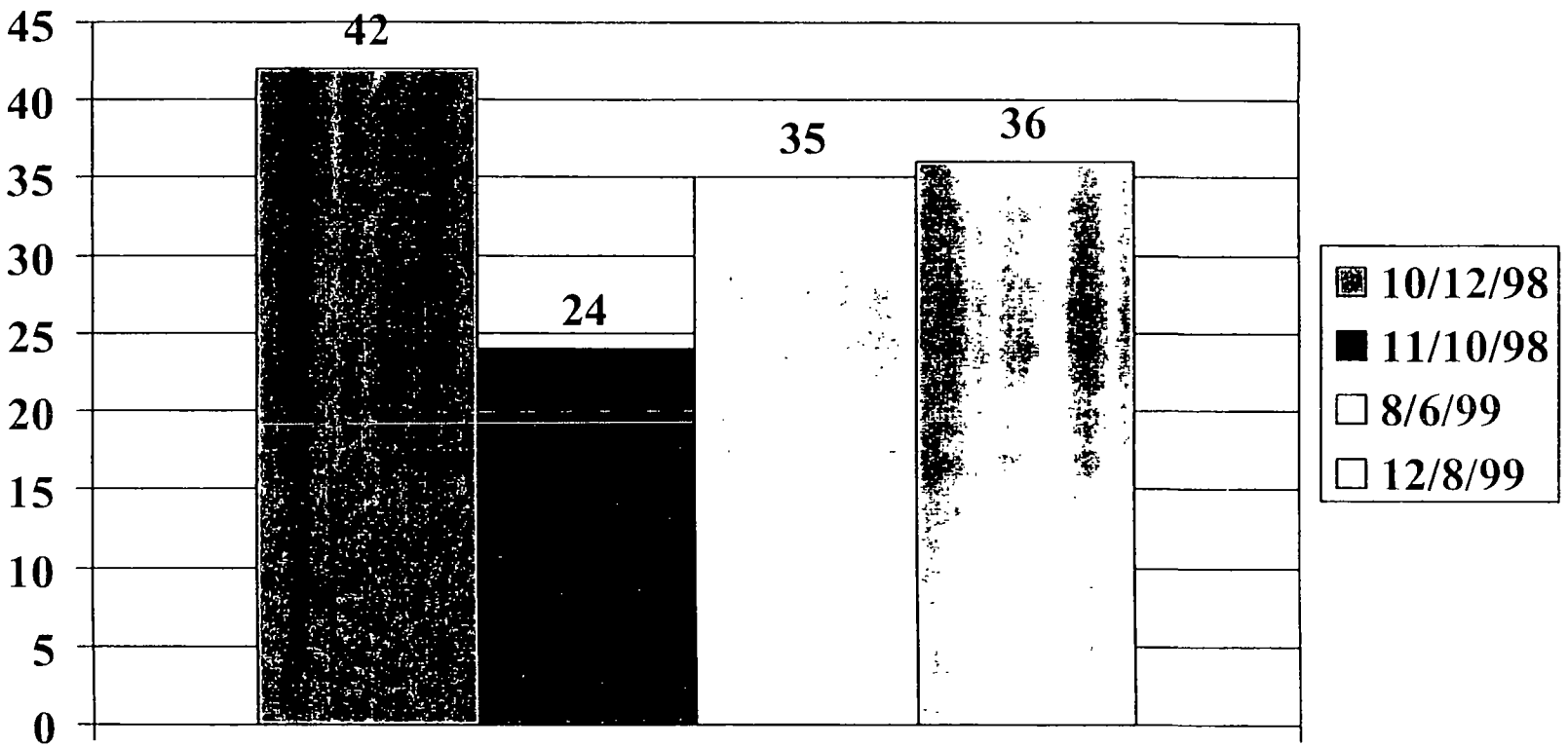


Figure 5. EPT Taxa Richness @ SV-769